Emerging markets for satellite data communications in the public service*

by JAMES G. POTTER
Public Service Satellite Consortium
San Diego, California

INTRODUCTION

The Public Service Satellite Consortium (PSSC) recently completed a study for NASA's Goddard Space Flight Center which addresses the basic requirements of four potential telecommunications markets in the public service: the U.S. health care system, elementary and secondary education, American libraries, and that sector of the public service which is concerned with the provision of continuing education to health professionals. The composite requirements of these and several other promising market groups are reviewed in this paper.

The potential demand in 1982 for satellite communication capacity from public service users is projected under the optimistic assumption that an appropriate satellite communication network will be available, a network in which numerous, inexpensive earth stations are located at the point of use. It is also assumed that there will be no “gap” in the development of public service satellite communications, which may occur if NASA's endangered species of experimental satellites, such as ATS-6 and CTS, cease to function adequately before a growing and influential community of public service users graduate to operational service on common carrier facilities.

PSSC's surveys among its members have reconfirmed what other studies have shown: that video applications are likely to predominate. Seven of the ten transponders projected by PSSC to support 1982 requirements are related to video applications. Four of these seven transponders already are committed to support public broadcasting. Six represent new markets.

What is surprising about PSSC's projections is evidence of a growing market for satellite data communications service. While projected 1982 channel capacity is modest (on the order of 90 MHz of bandwidth or three conventional satellite transponders), the potential transmission revenue is substantial. This potential revenue, which is estimated to be on the order of $100 million annually, dwarfs that which is likely to accrue from provision of private-line video service.

THE UTILITY OF COMMUNICATION SATELLITE NETWORKS

Throughout the public service there are three recurring needs: improved access, maintenance of quality, and containment of costs. The appropriate application of communications satellite networks could ameliorate each of these concerns. Indeed, low cost communications is a prerequisite for organizational arrangements which depend upon the substitution of communications for transportation to achieve higher productivity.

Synchronous communications satellites have generic properties which make them attractive vehicles for performing certain functions of interest to public service organizations:

1. Broadcasting, in which expensive audio-visual programs are aggregated at a few points of origination and distributed to many receivers, as in a TV or radio network.
2. Archiving, in which expensive computer capacity, data bases, audio-visual, and/or computer programs are concentrated at a few central locations where they may be accessed (and updated if appropriate) from a large number of remote points. An example is the computer utility of the Ohio College Library Center in Columbus, which is used by over 1100 libraries in 44 states to construct catalog cards and to purchase serials.
3. Flexible routing. It is possible to allocate the available capacity among the possible routes in the network in an extremely flexible manner. Although the demand for private-line communications satellite circuits from public service organizations may be in excess of $100 million in 1982, the geographic distribution of this traffic, its time distribution, the connectivity patterns, and the magnitude of the peak loads are unknown. The communications satellite will provide a cost-effective, “toe in the water” capable of aggregating related private-line requirements throughout a geographic region.

THE PUBLIC SERVICE SATELLITE CONSORTIUM (PSSC)

PSSC is a growing organization of over ninety non-profit public service agencies from the fields of education, health

---

* This work was sponsored in part by the Goddard Space Flight Center, Contract NAS 5-23865, under the direction of Dr. Edward A. Wolff.

---
care, library service, public broadcasting, and related interests. PSSC was created in 1975 to inform the public service user community about the capabilities of satellite technology and to facilitate aggregation of public service telecommunications requirements and resources.

Most individual public service organizations cannot now afford access to the sophisticated information systems presently (or soon to become) available. Before cost-effective information networks which are responsive to individual user requirements can become operational, it will be necessary to aggregate sufficient numbers of users to allow effective negotiations for core service requirements.

PSSC's role is that of a consultant and broker. It is important that the established carriers have access to comprehensive, objective information regarding the communications requirements of PSSC's members and that PSSC's members are aware of important capabilities which the established carriers can—and cannot—provide. Thus far PSSC has worked exclusively with NASA experimental satellites, but within the next year it will begin buying appropriate communications capacity in bulk from established carriers and re-selling this capacity in smaller increments to its members on a non-profit basis.

PSSC has been working with the State of California and an ad hoc committee of federal agencies, which includes the White House Office of Science and Technology Policy, the Agency for International Development, the Appalachian Regional Commission, the Department of Interior, the Department of Health, Education and Welfare, NASA, and the Veterans Administration, to develop an effective program for accelerating the transfer of communications satellite technology to the public service in the 1980s. Two alternatives are under discussion: (1) use of federal funds to place an appropriate communications payload on the Syncom IV satellite of the Hughes Aircraft Company, which will be launched by the Space Shuttle in 1980; and (2) a competitive service procurement involving established carriers and perhaps aerospace companies, whereby the federal government will provide incentives for the private sector to meet projected public service network requirements using relatively inexpensive satellite earth stations. There is agreement that the growing momentum within the public service community to use cost-saving communications technology must be nurtured without interruption and that public service users must pay some, and eventually all, of the fair price of providing needed service through established common carrier mechanisms.

BASIS FOR DEMAND PROJECTIONS

The projections to follow, while speculative, are based on two assumptions: that significant increases in telecommunications utilization will not occur over a five-year period unless:

1. The organization obviously will benefit from changing its way of doing business, and
2. The required organizational tremors will be mild.

The public service sector has been partitioned into three categories:

1. Category A—modest institutional adjustments are necessary and significant productivity gains are likely, resulting in "modest" risk to the supplier of telecommunications services. (More specifically, the risk is probably still too high for a common carrier in the absence of federal participation to reduce his downside risk; but the likelihood of successful market aggregation is relatively high.)
2. Category B—the institutional requirements picture shows promise, but more information is needed to assess probable benefits and risk.
3. Category C—major institutional adjustments are necessary, the risks to the communications supplier are high, but the possible benefits are also high. Examples include an electronic mail system tailored to the requirements of the U.S. Postal Service, or a telecommunications/computer system addressed to core curriculum subjects in elementary and secondary education, freeing the classroom teacher to concentrate on individual problems rather than mass problems. Small scale experiments which were addressed to "Category C" problems would be appropriate for inclusion in a NASA experimental program, although it may be years before a viable commercial market develops.

The time frame for the projections is 1982, using the best 1976 data available to PSSC. In general, it is assumed that approximately one-third of the total projected telecommunications traffic would be carried by a communications satellite if an appropriate network were available.

The projected levels of telecommunications utilization are based on estimates of what it costs the organization to do a job now—inefficiently. PSSC assumes, for example, that hospitals should not have to spend 10 percent of their annual operating budget on record-keeping functions and is attempting to promote increased use of information networks on this basis. PSSC is assuming implicitly, however, that once a hospital commits to increased use of computers and telecommunications, it will begin using the extra capabilities thereby made available to perform new, unforeseen tasks.

U.S. HEALTH-CARE SYSTEM

PSSC concluded in its study for NASA that the three opportunities which are most likely to lead to extensive utilization of satellite communications in the U.S. health-care system involve the aggregation and sharing of:

1. Computer power, data bases, and software for use in hospital information systems for accounting, billing, inventory control, and patient records;
2. Clinical-support systems for radiology, cardiology, and pathology; and
3. Audio-visual materials and programs for computer-managed instruction to support the continuing educa-
The U.S. health-care system has been plagued by rampant inflation. Whereas the Consumer Price Index increased by 98 percent in the period from 1950 to 1973, hospital costs increased by 600 percent. In this same period, the federal contribution to health-care costs increased from 25 to 40 percent. In an effort to contain these costs, the Carter Administration attempted to place a ceiling on the rate of increase in hospital expenditures of 9 percent a year in 1977. Although this proposal was not approved by Congress, the health-care industry was placed on notice that effective, voluntary cost-containment procedures must be developed or mandatory federal regulations are likely.

The average American hospital is estimated to spend $20 per patient per day on record keeping, an expense which amounted to $5.6 billion in 1976, or 10 percent of total expenditures. A number of companies, including Technicon, Shared Medical Services, Computer Sciences Corporation, and McDonnell-Douglas Automation, have developed effective automated record keeping procedures which have resulted in productivity gains in participating hospitals. Unfortunately, present indications are that only hospitals having in excess of 200 beds can justify the expense of a dedicated management-information system or can afford access to a shared system. Yet, 70 percent of the 7,174 hospitals in the U.S., many of which are located in rural areas, have less than 200 beds. The availability of an appropriate satellite data communications network would permit a larger fraction of U.S. hospitals to access the automated administrative-support systems which are now being used successfully by larger, urban hospitals.

The advantages of an automated hospital information system include: (1) reduced clerical personnel costs; (2) reduced incidence of lost charges and rejected claims; and (3) improved cash flow. Since such a large portion of health-care expenditures are reimbursed by a third party (e.g., Medicare, Blue Cross, or Blue Shield), use of central data bases and electronic information transfer can lead to a dramatic improvement in cash flow. The average payment cycle is reported to have been reduced from sixty days to twelve days in several California hospitals which recently implemented automated record keeping systems. Other advantages of hospital information systems which include the patient history are: (1) improved professional communications, which enhances continuity of care (the possibility of lost or incomplete records is reduced) and reduces the incidence of episodic care; (2) groups of patients at risk can be identified, and preventive medicine can be practiced systematically; (3) the quality of care can be audited more easily; and (4) the continuing education needs of the providers can be determined more systematically.

The disadvantages of automated record keeping systems are: (1) there are potential privacy problems (although no system is immune from unauthorized access); (2) the relative strengths and weaknesses of providers can be evaluated more systematically, which may or may not create barriers to acceptance; and (3) such systems require structured input, which necessitates annoying changes in the working routine of health practitioners.

In projecting the magnitude of the satellite data communications market in 1982, PSSC makes the following assumptions:

1. The rate of growth of hospital expenditures will stabilize at a compounded annual rate of 9 percent, as requested by the Carter Administration. (The rate of growth in 1975 and 1976 was about 14 percent, and total hospital expenditures amounted to $55.4 billion in 1976.)
2. Economies of scale resulting from use of a satellite data communications network will make hospital information systems cost effective for hospitals having at least fifty beds. (Hospitals having more than fifty beds accounted for 97 percent of total expenditures in 1976.)
3. Hospitals will continue to spend approximately 10 percent of their total budget on record keeping functions.
4. The percentage of the record keeping budget spent on automation (given that automated procedures are used at all) will remain at its present value of 12 percent.
5. The percentage of the automated record keeping budget spent on telecommunications will be 15 percent.
6. The percentage of telecommunications service provided by satellite will be 33 percent.

The projected 1982 satellite revenue is then: $(55.4B)(1.09)(0.97)(0.12)(0.15)(0.33)=49 million.

Preliminary information available to PSSC suggests that an American hospital performs an average of sixty-two record keeping transactions per patient per day. Approximately 270 million patient-days of service were administered by American hospitals having fifty beds or more in 1976. Assuming that the volume of traffic grows at a compounded rate of 9 percent, that 50 percent of the total volume is processed locally, that 33 percent of the remaining volume is carried by satellite, and that the average administrative form contains 8,000 bits but that only 50 percent of this information content needs to be transferred back to the data base in an average transaction, the estimated volume of hospital administrative traffic in 1982 is: $(270\times10^9)(1.09)^6(0.5)(0.33)(8,000)(0.5)=1.7\times10^{13}$ bits per year.

PSSC has not included possible traffic associated with clinical support services in its estimates. Three areas which show near-term promise are radiology, cardiology, and pathology. PSSC is evaluating these areas but does not now have sufficient information to estimate probable demand. One must exercise caution when projecting demand for telecommunications in clinical medicine. It would be logical to consolidate health-care delivery throughout a geographic region, substituting communications for travel and treating patients at the lowest possible level of a hierarchical health-care system in the interest of convenience, fairness, and cost. Dr. Maxine Rockoff of the National Center for Health Services Research notes a basic fallacy in this line of think-
ing, however: 15

"To the extent that the cost of care increases with each level in the hierarchy, avoiding referrals reduces costs, and benefits those who pay for care, including patients and insurers. But considered from the perspective of that 'next level up' whose expertise is to be brought to the patient via telecommunications technology instead of having the patient referred to it, this may be no benefit at all. Indeed, the pecuniary interests of the 'next level up' may be best served by maximizing referrals, not minimizing them."

A possible implication for those who wish to market telecommunications services to clinicians is that one should concentrate on the sharing of computer and audio-visual resources, not scarce human resources.

CONTINUING EDUCATION

In a survey which was administered in the summer of 1976, 81 percent of PSSC's membership expressed interest in a network for continuing education. More recently, PSSC conducted a survey of the membership to determine composite requirements for a federally subsidized Public Service Communications Technology Satellite (presumably Syncom IV with an appropriate communications payload). In the period between October 17, 1977 and January 10, 1978, forty-two public service organizations responded in writing or were interviewed by senior staff. Quantitative information regarding the probable demand for private-line video, voice, and data circuits was received from seventeen organizations.

The response was strongly oriented toward one-way video. If service which is comparable to that planned for Syncom IV (which is expected to provide an EIRP in excess of 43 dBW throughout the continental U.S.) is available at approximately $400 per transponder-hour, an estimated 8,170 channel-hours would be utilized annually by these seventeen organizations.

The projected volume of data communications traffic is modest. Assuming that 12,000 channel-hours of programming are delivered annually, that there are an average of 1,000 students per class, that the average student responds 16 times an hour, and that 30 bits of data are transferred per response, only $400 per hour of data need be transferred while maintaining individual records. The required system throughput is so low that the economics are significantly enhanced by relying exclusively on mark-sense cards and not allowing voice feedback, which tends to be ineffective in large-audience situations anyway.

A one-way video and two-way data network could combine the best features of pre-recorded lectures, live interaction, and computer-managed instruction. Even with production costs as high as $20,000 per hour and transponder costs of $400 per hour, it would be possible to administer such a network at a profit while charging course fees of approximately six dollars per student-hour if an average of 1,000 students per class could be attracted. 17

EQUIPMENT MAINTENANCE

Federal and state government agencies have extensive investments in equipment which is dispersed throughout the country. PSSC does not have adequate information regarding the dimensions of this requirement, but preliminary insight may be obtained from the experiences of the Federal Aviation Administration in its VORTAC (VHF Omni Range Tactical Communications) system. 18 In 1975 the FAA had a total maintenance budget of $320 million, of which 80 percent was personnel related. Through use of telemetry and centralization in its VORTAC program, the FAA could eliminate the need for many on-site technicians and spare parts, which would result in a considerable savings. Studies by the Mitre Corporation indicate that the maintenance budget for the VORTAC program, which amounted to $38 million in 1975, could be reduced to approximately $10 million annually through appropriate use of telecommunications.

Use of telemetry, microprocessors, and telecommunications probably could effect tremendous savings in equipment
maintenance and load management of various resources (power, water, light, heat, air conditioning, oil and gas pipeline flow, control of traffic lights and vehicular flow, etc.). To gain a tentative estimate of the volume of the associated telecommunications service, PSSC makes the following assumptions:

1. The total investment in capital equipment by public service agencies is $100 billion, an amount which is growing at 5 percent annually;
2. Five percent of this equipment is subject to savings through appropriate use of telemetry and centralized maintenance procedures;
3. The annual maintenance cost averages out to be 10 percent of the capital cost of the equipment;
4. In those cases where savings can be effected through use of telemetry, 15 percent of the maintenance budget is associated with telecommunications service; and
5. One-third of the resulting traffic is carried by satellite.

The resulting estimated potential satellite traffic is: $100B\cdot (1.05)^5\cdot (0.1)\cdot (0.33) = \$32 million.

The annual bit rate is projected under the assumption that the average cost of this dispersed equipment is $25,000, that thirty-two bits of data are sufficient to address and encode the message, that each piece of equipment is interrogated every ten minutes on the average, and that all of this information is relayed by satellite: $(100B/25K)\cdot (1.05)^5\cdot (0.05)\cdot (0.1)\cdot (0.33)\cdot (10)\cdot (4,800) = 4.3 \cdot 10^{11} \text{ Bits/Year}.

ENVIRONMENTAL MONITORING

The National Oceanic and Atmospheric Administration (principally the National Weather Service), the Environmental Protection Agency, the U.S. Geological Survey, the Corps of Engineers, the Department of Agriculture, and the Department of Interior all have extensive requirements for monitoring atmospheric, edaphic, and/or oceanic data. Ecosystems International Inc., under contract to the Goddard Space Flight Center, determined that in 1975 these agencies maintained 90,714 stations in the U.S. having an average of four sensors apiece.26 The annual cost of this operation is estimated to be $98.3 million and the volume of information is $1.36 \cdot 10^{11} \text{ Bits/Year}.$ Only 6 percent of these platforms are remotely interrogated at the present time. PSSC estimates that if an appropriate satellite data communication network were available, environmental monitoring would contribute another $5 million of business annually. In arriving at this estimate, it is assumed that 10 percent of the present $100 million budget would be spent on telecommunications services, of which half would be directed to satellite carriers.

OTHER POTENTIAL MARKETS

PSSC does not have sufficient information to evaluate a number of other promising candidates for service. Other possibilities are:

- Department of Defense training
- Training of other federal and state employees
- Law enforcement (fingerprint data, automobile registration and license information, LETS, and NCIC functions)
- Access to data regarding eligibility for welfare benefits
- Search and rescue/disaster relief
- Internal Revenue Service, Social Security data transfer
- Job bank involving the Department of Labor
TABLE I.—Projected Market for Public Service Satellite Communications
(1982)

<table>
<thead>
<tr>
<th>Service Sector</th>
<th>Est. Revenue</th>
<th>Est. Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Hospitals</td>
<td>$ 49M</td>
<td>1.7×10^14 Bits/Year</td>
</tr>
<tr>
<td>Equipment Maintenance</td>
<td>$ 32M</td>
<td>4.3×10^14 Bits/Year</td>
</tr>
<tr>
<td>American Libraries</td>
<td>$ 15M</td>
<td>1.0×10^14 Bits/Year</td>
</tr>
<tr>
<td>Continuing Education</td>
<td>$ 5M</td>
<td>5.8×10^10 Bits/Year</td>
</tr>
<tr>
<td>Public Broadcasting</td>
<td>$ 4M</td>
<td>Four video channels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Four 15 kHz audio channels</td>
</tr>
<tr>
<td>Environmental Monitoring</td>
<td>$ 5M</td>
<td>6.8×10^6 Bits/Year</td>
</tr>
<tr>
<td>Total:</td>
<td>$110M</td>
<td>Four Western Union transponders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Six additional transponders</td>
</tr>
</tbody>
</table>

SUMMARY OF TRAFFIC PROJECTIONS

PSSC's projections of "Category A" service sectors are summarized in Table I. Seven video transponders, which represent space-segment revenues of $9 million annually, and three additional transponders for data, which represent total transmission revenues of $101 million, are projected. Four of the projected seven video transponders will be used by public broadcasting, which has entered into a seven-year contract with Western Union. In addition, approximately one-third of a Western Union transponder will be used by National Public Radio to distribute four 15 kHz audio channels to its licensees.

In a large network of small stations, the space-segment revenue associated with the estimated data traffic will amount to approximately 20-30 percent of the total, or $20-$30 million. It is noteworthy that such a small amount of bandwidth could generate so large a revenue—given adequate market aggregation.

COMMENTS ON THE NATURE OF THE TRAFFIC

PSSC’s near-term market projections are dominated by the requirements of the health-care industry, both in terms of volume and revenue. Public education is conspicuous by its absence. Dr. Louis A. Bransford, Director of Service Development of PSSC, concluded in the recent market study for NASA:23

"The structure of the present system of public education in America, both economically and programmatically, appears to be inconsistent with the requirements of a broadly-based telecommunications network. Implementation of a comprehensive information network may face organized resistance and probably will take years to accomplish."

The projected volume of satellite data communications traffic is on the order of 2×10^13 bits per year. To place this figure in perspective, a single Satellite Business Systems transponder operating continuously at 50 megabits per second has a peak capacity of 1.6×10^13 bits per year, about an order of magnitude higher than that required to support projected public service requirements, assuming that the peak load will be about ten times the average load. The earth stations which SBS allegedly plans to install have a capital cost of approximately $474,000.24 The possibility of exchanging reduced system throughput for reduced earth-station cost immediately suggests itself.

Table II was suggested by Norman Abramson of the Aloha Systems Project, who is an expert on “affordable” satellite data communications.25 Dr. Abramson advocates use of a packet-switched satellite data communications network, operating at a speed somewhere between one and two orders of magnitude below the SBS network. For concreteness, Table II assumes a system throughput of five megabits, although this figure is arbitrary and not the result of a cost-performance evaluation.

In a network which is composed of many point-to-point links which interconnect a large number of nodes, such as the Bell System's Direct Distance Dialing Network for message telephone service, it is not economical to connect every node to every other node. Rather, the messages are routed through a hierarchy of nodes, using expensive switching machines to provide the necessary connectivity. When the application calls for direct connection of nodes, as in broadcasting or archiving, the additional links and switching machines of a hierarchical network add unnecessary cost, complexity, and noise to the system. Dr. Abramson observes:26

"The natural structure of satellite communications links does not require the establishment of point-to-point communications channels in the traditional sense. A more natural form for satellite communications resources is a broadcast structure, allowing each network node to communicate directly with every other network node. The communications architecture which best matches the broadcast structure of the satellite communications channel is therefore one which starts from the premise that communications can proceed from many transmitters to many receivers in a communications environment analogous to that of a multi-person conference. And in the case of data communications it is possible to implement such a broadcast architecture using small earth stations."

<table>
<thead>
<tr>
<th>Application</th>
<th>Capacity</th>
<th>Capacity Using Low-Cost Earth Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Data</td>
<td>50 Mbps</td>
<td>5 Mbps</td>
</tr>
<tr>
<td>Two-Way Video</td>
<td>One Conversation</td>
<td>Not Applicable*</td>
</tr>
<tr>
<td>Two-Way Audio</td>
<td>800 Conversations</td>
<td>80 Conversations</td>
</tr>
<tr>
<td>3,000 Word Reports</td>
<td>400 Reports/Sec.</td>
<td>40 Reports/Sec.</td>
</tr>
<tr>
<td>200 Word Messages</td>
<td>6,250 Messages/Sec.</td>
<td>625 Messages/Sec.</td>
</tr>
<tr>
<td>Interactive Computer</td>
<td>500,000 Active Users</td>
<td>50,000 Active Users</td>
</tr>
</tbody>
</table>

* Two-way video would not be physically impossible in this hypothetical network, but the earth stations probably would cost at least $85,000 apiece. PSSC assumes arbitrarily that earth stations must cost less than $25,000 in an "affordable" satellite communications network.
To make a satellite data communications network for modest-throughput requirements more affordable, Dr. Abramson suggests that: (1) multiple access of the transponder be accomplished using Aloha-type packet-switching techniques; (2) the satellite transponder be designed to transmit at a peak power which is approximately ten times higher than the average power; and (3) that such transponders use relatively narrow bandwidths (about two MHz). With these modifications, the required sensitivity of two-way data earth stations could be reduced substantially and/or the system throughput could be maintained at levels which approach those attainable with more expensive TDMA multiple-access procedures. But if conventional satellite transponders are used in the early 1980s to meet public service data communications requirements, it is still likely that the earth stations can be built in lots of 50 for less than $25,000 apiece. Hughes Aircraft already has developed a similar earth station for operation at four and six GHz which it plans to market for about $25,000. 27

CONCLUSION

The communications capacity required to serve some important public service requirements is modest, and the potential revenue is significant. What is needed is a cooperative effort by common carriers and major public service institutions to aggregate the market. The federal government may or may not elect to accelerate the communications-technology transfer process by providing initial subsidies. In any case, PSSC will continue to focus on the requirements of its members and to impress on the carriers that there is money to be made by responding to these requirements.

ACKNOWLEDGMENTS

PSSC’s information regarding the requirements of the health-care industry was assembled primarily by Dr. Thomas E. Terrill of the Akron City Hospital in Akron, Ohio. The material concerning continuing education was synthesized by Ms. Kathleen King of PSSC’s staff and by Ralph P. Christenson, M.D. I am indebted to Dr. Norman Abramson of the University of Hawaii and to Gregory Nichols of PSSC’s staff for numerous insights concerning network architecture and systems engineering. To John Witherspoon, President of PSSC, I owe most of the insights I have obtained regarding the institutional factors which will be the predominant influence underlying the ultimate acceptability of the emerging communications techniques which now show such promise in the public service.

REFERENCES


13. PSSC’s consultant on information retrieval, Martha E. Williams of the University of Illinois, reported in August 1977: “A rule of thumb in the information industry is that telecommunications accounts for 10 to 15 percent of the total cost of an information service.”

14. The assumptions of this paragraph are based largely on the experiences of Intermountain Health Care, Inc., an 18-unit health-care complex in Utah.


